Mobile ActDresses: Programming Mobile Devices by Accessorizing

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Abstract
Mobile ActDresses is a design concept where existing practices of accessorizing, customization and manipulation of a physical mobile device is coupled with the behaviour of its software. With this interactivity demonstrator we will provide a hands on experience of doing this kind of playful manipulation. We provide two examples for how to implement Mobile ActDresses using quick'n dirty hacks to create custom shells and jewellery for controlling the behaviour of the phone.

Keywords
Mobile Devices; Tangible Interaction; Accessorizing

ACM Classification Keywords
H.5.2 [Information Interfaces And Presentation]: User Interfaces - Interaction styles;

Introduction
We have explored the metaphor of physical clothing, accessorizing and labelling as an alternative mode of controlling mobile interactive systems. A general motivation for this approach is that people already do personalise their digital devices by various physical means. Mobile phone handsets are personalized by placing stickers on them, people buy or make their own customized cases, and they attach mascots and

Figure 1. Common practices of customizing the physical surface of mobile phones (top), as well as the appearance of its digital content (bottom).

decorative charms [5]. Another motivation concerns the use of personalised digital themes and the growing amateur practices of making small and personal mobile applications. The mobile phone as such is thus not merely a tangible interactive device but also an object for personal expression. Mobile ActDresses thereby takes advantage of well-established practices of on the one end physical personalization of mobile devices such as shells and accessories, and on the other end stitches it together with software applications, games, media or complete themes (see Figure 1).

Here we present an interaction scenario, an overview of the technical explorations and the resulting demonstrator. We end by outlining a series of design challenges yet to be addressed in future explorations.

Background and Related Work

ActDresses as a design concept could be summarized as controlling or predicting the behaviour of interactive devices by attaching visible physical items to their immediate context [1][4]. These items could take the forms of text labels, pictures, or three-dimensional objects traced using detection over distance (e.g. RFID, NFC, Bluetooth, IR, sound, vision-based technology) or direct contact ID technology (e.g. iButtons, USB, vibration, and resistors). The design space also ranges conceptually from single on/off mode switchers to more complex configurations with combinations of such active labels and accessories.

Previous experiments on this theme have concerned control of robotic systems, grounded in empirical studies of user interaction with commercial products [3][7] and tangible media [8]. Another motivation concerns how clothes are worn by people to serve a range of communicative functions, indicating e.g. appropriate behaviours, group belongings, and expected interactions [2]. Similarly, physical accessories attached to a device could be used as a resource to indicate what mode the device is currently in, and what behaviours and interactions that could be expected. Our goal with the current exploration is to broaden this work to explore how the approach could be extended to handheld devices.

Interaction Scenarios

In the outlined design concept, people are able to attach physical accessories to their mobile phone handset and by doing that change its digital functionality or appearance in some way. To make this general design concept easier to grasp, we here provide a short scenario of imagined use.

A day in my Mobile Life

Jill rarely takes any step without her mobile phone, which she everyday customises physically as well as digitally to match her own clothes of the day. Thereby the phone itself works as a fashion item that she likes to match with her outfit. Just before entering her office, Jill attaches the company shell to her mobile phone handset, which makes the phone work both to let her into the building, as well as a company identity marker and label on her phone. Plus, it goes well with her outfit. The phone is now set into a mode that switches her contact list so that it automatically loads her work contacts as her primary address book in the phone. While the shell is on, also all charges on the phone get placed on the company rather than on her personal phone bill. When leaving the office she immediately takes the shell off her phone, which then replaces her office applications with her favourite spare time

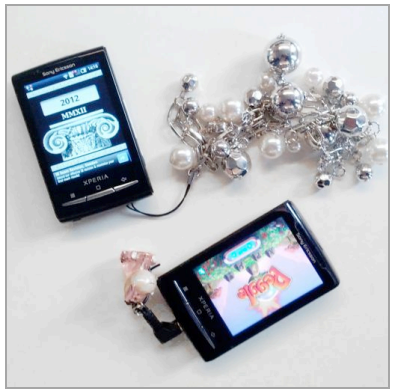

Figure 2. Headphone and jewellery hack to control applications and other content.

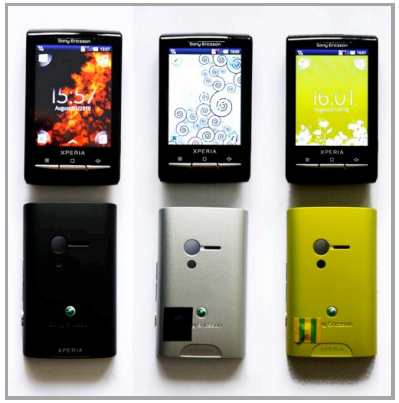

Figure 3. Mobile phone prototype using magnets on shells to control themes and other content.

applications on the front screen. Later in the evening Jill goes out for a drink and attaches her 'after work jewellery' that allows her to pay her drinks with the phone so that the purse can be left at home.

Technical Explorations

Here we elaborate on different strategies for implementing and deploying the scenarios outlined above based on existing standards on mobile phones on the market today.

There are many forms of wireless technologies available for mobile phone handsets, and that potentially could be used to identify physical objects. However, wireless protocols such as Bluetooth and WiFi requires active transmitters and also have relatively long range of communication, features that oppose the outset of having signs in the immediate physical context of the device that they control. Infra Red (IR) is another available technology with similar properties, but one that currently is being phased out. Using a camera together with e.g. barcodes requires more explicit reading and is a poor match to the scenarios in the sense that it conflicts with the immediate physical context requirement by obscuring the camera. Sound would be interesting in the sense that microphones are perhaps the most widely available technology, but is likely to require both active (or activated) transmitter and a fairly sophisticated detection service.

Another wireless method that could be appropriate in this case is NFC, which enables the exchange of data between devices up to a 10-centimetre distance. This would work similarly to the well-explored use case where the phone is used for reading passive NFC tags (e.g. for reading smart poster labels [6]). Central drawbacks in this case are that the reading must be constantly active on the device and that most devices currently do not support reading of multiple tags simultaneously.

As with the wireless protocols, there is a range of possible solutions for using wired or direct contact connections for realizing the basic concept that we explore here. Examples, include experimental solutions such as Pin & play, iButtons, conductive stickers, resistors, USB, or even the built in memory cards.

In our interactivity demonstrator (Figure 3), we present a solution based on physical shells equipped with small but strong Neodym (NdFeB) magnets positioned at different locations. The absolute distance between the magnet and the magnetometer in the phone is sensed, and can be used to trigger events in software. In this case a simple service application was developed that changes the theme on a mobile Android phone according to the style of the shell. Furthermore, we show how the headphones/handsfree jack can be used as an example of a wired ActDress together with jewellery (Figure 2). To extend this demo and to illustrate the many possible actions that could be triggered, it has been made to not only change its visual theme but also twitter its change online.

Future Design Challenges

As a guide for directing ourselves towards the design concept from a perspective of user experience, we here focus on the different ways that physical interactive artefacts may work as resources for human action and experience, e.g. for physical manipulation, for perception and sensory experience, contextually oriented action, and digitally mediated action [2].

Apart from offline physical manipulations, this includes e.g. the importance of physical nearness when using NFC, and how a wired connection may be physically manipulated. The case of USB implies that physical 'sockets' restricts positioning of tags whereas the wireless solution can be designed to be both free and 'socketed'. Furthermore, as USB connection is not meant for permanent coupling, it may easily fall out in ordinary mobile phone usage situation.

Perception and sensory experience
An important part of the design concept concerns personal, bodily and emotional engagement, e.g. how the ActDresses feels like to hold, touch, to look at and to listen to. The physical items, as well as the digital functions that they trigger, may in many ways shape how these are made sense of. A physical 'contract' in the form of a physical wire would for instance give a subtle 'enabled/disabled' tell whereas a free tag e.g. RFID-tag enters or leaves an invisible frictionless space. This fact seems to speak in favour of direct contact methods.

Digitally mediated actions
We also need to consider how the ActDresses coexists with the various forms of media or applications made accessible through the device, how they are captured, generated, communicated, controlled and manipulated. Depending on the implementation, Mobile ActDresses may for instance provide richer forms for accessing online, recorded and interactive media, or for digitally mediated social communication.

For example, the solution of using the inbuilt compass sensor together with strong magnets will naturally hinder and completely disturb the ordinary uses of the compass sensor. Also, no matter mode of interaction, sensing technology and physical connectivity, central design choices concern the exact design of how and what digital actions that these trigger.

Conclusions

We provide a simple proof of concept demonstrator. It shows how existing technology can be altered for new purposes, and also provides a testbed for future user studies and design experiments that will hopefully guide us towards a better understanding of new modes for interaction with tangible objects.

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